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REPORT FOR CONSULTATION ON THE METROPOLITAN SIOUX FALLS INTERSTATE AIR QUALITY CONTROL REGION (SOUTH DAKOTA-IOWA-MINNESOTA)

National Air Pollution Control Administration
Washington, D. C.

July 1970

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The basic background information is presented for the consultation with state and local authorities prior to the designation of air quality control regions as stipulated in the Clean Air Act. Boundaries for the regions are proposed and the factors which are the basis for the proposed boundaries are discussed. Reports for consultation consider these factors: geography; population and economic activity; their prospective growth; probable direction of physical growth; the emission inventory and the location of sources; air quality and pollution transport analysis; regional planning; air pollution control; and governmental jurisdictions.

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INTERSTATE AIR QUALITY CONTROL REGION

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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Environmental Health Service
National Air Pollution Control Administration

July 1970

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PREFACE

The Clean Air Act, as amended, directs the Secretary of Health, Education, and Welfare to designate "air quality control regions" to provide a basis for the adoption of regional air quality standards and the implementation of those standards. The Act stipulates that the designation of a region shall be preceded by consultation with appropriate State and local authorities. This report is intended to provide the basic background information needed for the consultation. It proposes boundaries for the Metropolitan Sioux Falls Interstate Air Quality Control Region and discusses the factors which are the basis of the proposed boundaries.

The Region* boundaries proposed in this report remain subject to revisions suggested during consultation with State and local authorities. Formal designation of the Region will be made only after a careful review of all opinions and suggestions submitted during the consultation process.

The National Air Pollution Control Administration appreciates assistance received from the States of South Dakota, Iowa, and Minnesota, and the local governments and planning agencies in the area.

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*For the purposes of this report, the word "region", when capitalized, will refer to the Metropolitan Sioux Falls Interstate Air Quality Control Region.

INTRODUCTION

THE REGIONAL APPROACH

Air pollution in the urban areas of the United States is a regional problem which frequently extends across governmental boundaries. Since air pollution problems are rarely confined to any single municipality or county, and are often not confined within a single State, successful control requires coordinated planning, standard setting, and enforcement by the several political jurisdictions which share a common problem. To date, State and local governments across the Nation have only begun to develop a regional approach to air pollution control.

The Clean Air Act, as amended, provides a regional approach which depends upon coordination and cooperation among all levels of government--municipal, county, State, and Federal. To set in motion the machinery for regional air pollution control, the Department of Health, Education, and Welfare designates air quality control regions (following consultation with State and local officials), issues air quality criteria, and publishes reports on control techniques. The designation of region boundaries indicates which State and local jurisdictions will be involved in a regional air pollution control effort. The air quality criteria indicates the extent to which various concentrations of air pollutants are harmful to health and damaging to

property. The reports on control techniques provide information on the costs and effectiveness of various techniques for controlling air pollutant emissions.

After the Department of Health, Education, and Welfare completes these initial steps, State governments develop air quality standards and plans for implementation of such standards within the boundaries of designated air quality control regions. An air quality standard for a region defines the desired limit of concentration of a pollutant in its ambient air. It represents the level of air quality which the regional control program will attempt to achieve. An implementation plan is a blueprint of the steps which will be taken to attain chosen regional air quality standards within a reasonable time. The Clean Air Act requires that within 90 days after the Secretary of Health, Education, and Welfare has designated the region, State Governors must submit letters indicating that they intend to set air quality standards for those pollutants for which criteria and control technology documents have been issued. They have an additional 180 days to set the standards. The procedure for setting standards includes a public hearing which allows residents of a region to express their views concerning the proposed standards. The Governors are required to submit to the Secretary, within an additional 180 days, plans for the implementation of the standards which have been adopted.

The Department of Health, Education, and Welfare reviews air quality standards and implementation plans in order to ascertain their consistency with the provisions of the Act.

When air quality standards and implementation plans are approved, States proceed to prevent and control air pollution in accordance with those standards and plans. This system for establishing a regional approach to air pollution control is outlined in Figure 1.

DESIGNATION OF AIR QUALITY CONTROL REGIONS

Designation of an air quality control region is one of the first steps in the regional approach to air pollution control. Section 107 (a) (2) of the Clean Air Act, as amended, directs the Secretary, Department of Health, Education, and Welfare to make such designations. The portions of the section relevant to this discussion state:

> "...The Secretary, after consultation with appropriate State and local authorities shall...designate air quality control regions based on jurisdictional boundaries, urban-industrial concentrations, and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards. The Secretary may...revise the designation of such regions...The Secretary shall immediately notify the Governor or Governors of the affected State or States of such designation."

Procedure for Designation of Regions

Figure 2 illustrates the procedures used by the National Air Pollution Control Administration (NAPCA) for designating air quality

HEW DESIGNATES AIR QUALITY CONTROL REGIONS.
HEW DEVELOPS AND PUBLISHES AIR QUALITY CRITERIA BASED ON SCIENTIFIC EVIDENCE OF AIR POLLUTION EFFECTS.
HEW PREPARES AND PUBLISHES REPORTS ON AVAILABLE CONTROL TECHNIQUES
90 DAYS
STATES INDICATE THEIR INTENT TO SET STANDARDS.
(PUBLIC HEARINGS)
180 DAYS
STATES SET AIR QUALITY STANDARDS FOR THE AIR QUALITY CONTROL REGIONS.
180 DAYS
STATES ESTABLISH COMPREHENSIVE PLANS FOR IMPLEMENTING AIR QUALITY STANDARDS.
STATES SUBMIT STANDARDS FOR HEW REVIEW.
STATES SUBMIT IMPLEMENTATION PLANS FOR HEW REVIEW.
STATES ACT TO CONTROL AIR POLLUTION IN ACCORDANCE WITH AIR QUALITY STANDARDS AND PLANS FOR IMPLEMENTATION.

FIGURE 1 - Flow Diagram for Action to Control Air Pollution on a Regional Basis, UNDER THE CLEAN AIR ACT, AS A

FIGURE 2 - Flow Diagram for the Designation of Air Quality Control Regions

control regions.

After evaluating relevant technical and urban factors in a region, the National Air Pollution Control Administration publishes a proposed delineation of its boundaries. At the same time, NAPCA sets a time and place for a consultation meeting and distributes to State and local authorities a report of the evaluation study (such as this "Report for Consultation") which includes the boundary proposal. At the consultation meeting State and local authorities are encouraged to present fully their views and suggestions concerning the proposed boundaries of the region. Interested parties who do not have official status may submit comments in written form for the record. After careful review of all suggestions and opinions submitted for the record by interested parties, the Secretary of Health, Education, and Welfare makes a formal designation of the region boundaries and notifies the Governor(s) of the State(s) affected by the designation.

The Size of a Region

As stipulated in Section 107 (a) (2), the designation of air quality control regions should be based on "jurisdictional boundaries, urban-industrial concentrations and other factors including atmospheric areas necessary to provide adequate implementation of air quality standards." This language suggests a number of objectives which are important in determining how

large an air quality control region should be. Basically, these objectives can be divided into three separate categories.

First, a region should be self-contained with respect to air pollution sources and receptors. Unfortunately, since air pollutants can travel long distances, it is impractical if not impossible to delineate regions which are completely self-contained. The air over a region will usually have at least trace amounts of pollutants from external sources. During episodic conditions, such contributions from external sources may even reach significant levels. Conversely, air pollution generated within a region and transported out of it can affect external receptors to some degree. It would be impractical and inefficient to make all air quality control regions large enough to encompass these low-level trace effects. The geographic extent of trace effects overestimates the true problem area which should be the focus of air pollution control efforts. Thus, the first objective, that a region be self-contained, becomes a question of relative magnitude and frequency. The dividing line between "important influence" and "trace effect" will be a matter of judgment. The judgment should be based on estimates of the impact a source has upon a region, and the level of pollution to which receptors are subjected. In this respect, annual and seasonal data on pollutant emissions and ambient air concentrations are a better measure of relative

influence than short term data on episodic conditions. In summary, a region should include most of the important sources in the area as well as most of the people and property affected by those sources.

The second general objective requires that regional boundaries be designed to meet not only present conditions but also future conditions. In other words, the region should include areas where industrial and residential expansion are likely to create air pollution problems in the foreseeable future. This objective requires careful consideration of existing metropolitan development plans, expected population growth, and projected industrial expansion. Such considerations should result in the designation of regions which will contain the sources and receptors of regional air pollution for a number of years to come. Of course, regional boundaries need not be permanently fixed, once designated. Boundaries should be reviewed periodically and altered when changing conditions warrant readjustment.

The third objective is that regional boundaries should be compatible with and even foster unified and cooperative governmental administration of the air resource throughout the region. Because air pollution usually extends across governmental boundaries, the cooperation of several governmental bodies is required for the solution of a common set of air pollution problems. In this regard, the established patterns of governmental cooperation

on a range of urban problems is an important consideration, and the pattern of cooperation among existing air pollution control programs is a particularly relevant factor. In general, administrative considerations would argue against the division of governmental jurisdictions. Although it would be impractical to preserve State jurisdictions undivided, usually it is possible to preserve the unity of county governments by including or excluding them in their entirety. Occasionally, even this would be impractical due to a county's large size, wide variation in level of development, or striking topographical features.

To the extent that any two of the above three objectives lead to incompatible conclusions concerning region boundaries, the region must represent a reasonable compromise. A region should represent the best way of satisfying the three objectives simultaneously.

As noted above, the evaluations of relevant technical, urban, and governmental factors form the basis of the boundary proposals published by NAPCA. The technical factors study takes account of the location of pollution sources and the geographic extent of serious pollutant concentrations in the ambient air. Pollution sources are identified through an inventory of emissions from power generation, industrial operations, space heating, waste disposal, and other pollution-causing activities. The transport and distribution of pollutants in the ambient air are

analyzed on the basis of measured air quality data, the location of emissions, meteorological data, and topographic information. A mathematical diffusion model which predicts ambient pollution concentrations from information on emissions and meteorology can be used in areas where irregular topographical features would not invalidate the theoretical model. As a whole, the technical factors study indicates how large the air quality control region should be in order to encompass most pollution sources and most people and property affected by those sources.

The study of urban factors takes account of a different set of considerations. It discusses the location of urban and industrial concentrations and expected patterns of urban growth. As a whole, the urban factors study indicates how large a region should be in order to encompass expected regional growth.

The evaluation of the regional governmental organizations discusses the planning agencies, councils of government, and state and local air pollution control programs. This study attempts to define the combination of counties which, through cooperative regional arrangements, would best work together towards achieving clean air in the region.

The body of this report contains a proposal for the boundaries of the Metropolitan Sioux Falls Interstate Air Quality Control Region following evaluation of technical, urban, and governmental factors. The report is intended to serve as the

background document for the formal Consultation between the National Air Pollution Control Administration and the appropriate State and local authorities.

EVALUATION OF URBAN FACTORS

The size, shape, nature, and dynamics of urbanization within the region are factors of major importance in considering boundaries for an air quality control region. The concentration of population and employment in urban centers results in the creation of many potential sources of air pollution and the exposure of large numbers of people and valuable property to the effects of pollution.

In this discussion of the Metropolitan Sioux Falls area, the geography of the region is reviewed since its locational and physical characteristics can affect both the scale and direction of urban growth. Also considered are the area's population and economic activity patterns, both at present and as they appear likely to be in the future. Future growth and its implications for the physical configuration of the urban area is of particular importance in determining the size of the air quality control region.

GEOGRAPHY AND PAST DEVELOPMENT OF THE REGION

The Metropolitan Sioux Falls study area is defined for the purposes of this report as the Sioux Falls Standard Metropolitan Statistical Area (SMSA) County of Minnehaha and the five adjacent counties--Lincoln, McCook, and Turner in South Dakota, Lyon in Iowa, and Rock in Minnesota (Figure 3).

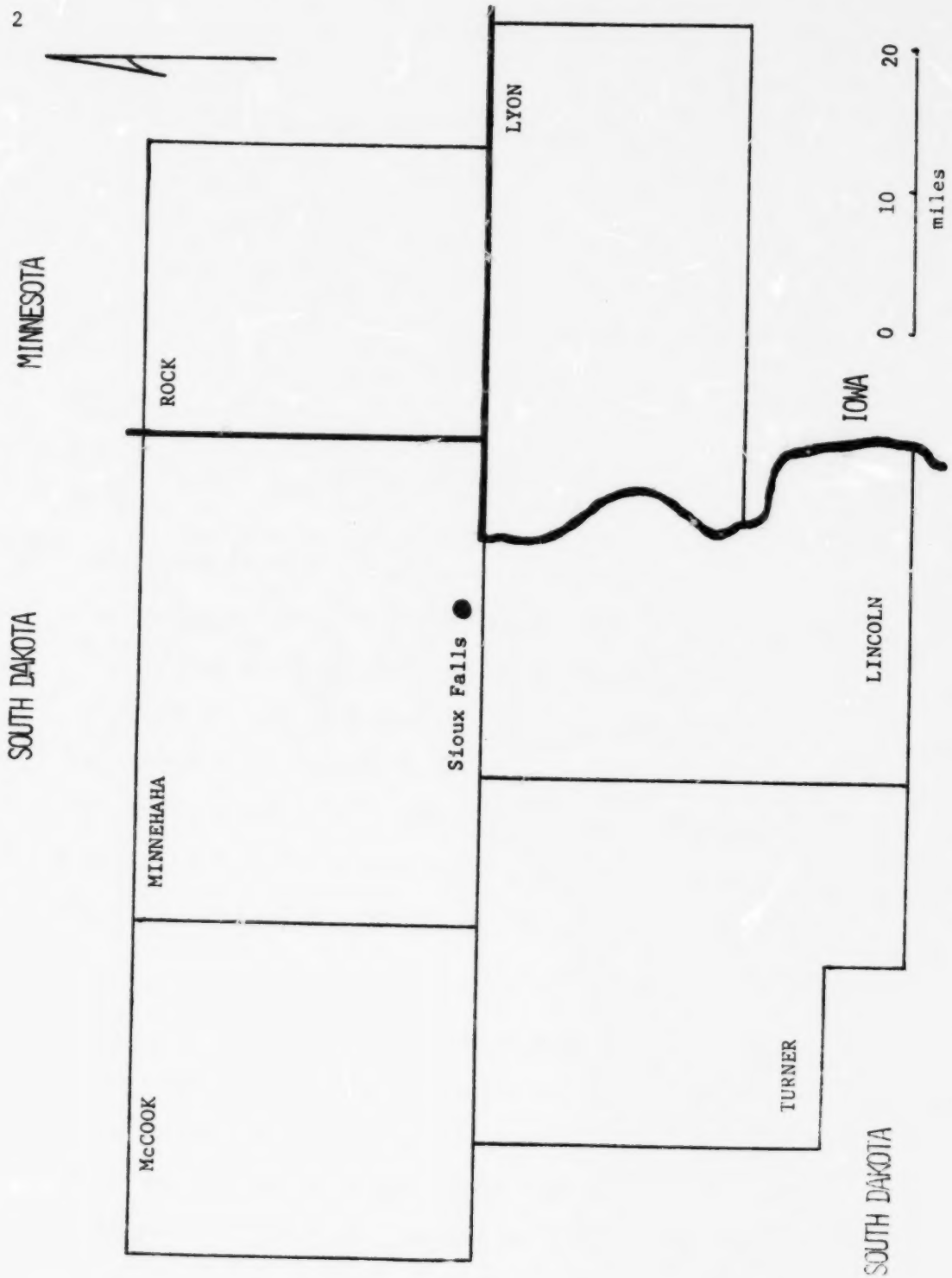

FIGURE 3 - South Dakota, Iowa, and Minnesota Counties Included in Metropolitan Sioux Falls Study Area

Sioux Falls, the only large city in the area, is located in the Big Sioux River Valley in the southeastern portion of South Dakota. The city is about 15 miles west of the Minnesota line and seven miles west-northwest of the Iowa line. The elevation of the city is approximately 1,400 feet above sea level. The surrounding terrain is gently rolling. Within a 100-mile radius of the city, elevations slope upward 300 to 400 feet to the north and northwest, and slope downward 200 to 300 feet to the southeast. There is little change in the other directions.

From its founding in the mid-eighteenth century to the present time, Sioux Falls has grown steadily with the expansion of farm production. With the coming of the railroads, Sioux Falls has become a major wholesale and retail distribution center serving various farming needs. At the present time, with the construction of Interstate Highways 29 and 90 which cross at Sioux Falls, the city is growing in importance as an industrial and manufacturing center.

PRESENT POPULATION AND ECONOMIC ACTIVITY PATTERN OF REGION

Table I summarizes the most recent available population figures for the Metropolitan Sioux Falls study area counties and for comparison purposes shows the 1950 and 1960 population figures. Minnehaha County, where Sioux Falls is located, with

Table I

Population of Metropolitan Sioux Falls Area Counties, 1950, 1960, 1968 and 1970

Counties	Population 1950	1960	1968 & 1970
Sioux Falls SMSA, Total	(70,910)	(86,575)	(95,271)
Minnehaha (South Dakota)	70,910	86,575	95,271
Adjoining Counties, Total	(59,670)	(58,130)	(54,522)
Lincoln (South Dakota)	12,767	12,371	11,445
McCook (South Dakota)	8,828	8,268	7,130
Turner (South Dakota)	12,100	11,159	9,696
Lyon (Iowa)	14,697	14,468	15,150
Rock (Minnesota)	11,278	11,864	11,101
Grand Totals	130,580	144,705	149,793

Sources: All 1950 and 1960 population figures are from the U. S. Census. All South Dakota 1970 population figures are from the preliminary 1970 U. S. Census.

Lyon population estimate for 1968 is from the Iowa Vital Statistics Division in cooperation with the U. S. Census Bureau. Rock population estimate for 1968 is from the Minnesota Department of Employment Security.

a population of 95,271, comprises 63 percent of the entire six-county study area which has a population of 149,793. Further, Sioux Falls, with a population of 72,557 makes up 48 percent of the area's population. There are no other cities in the area with a population over 5,000 (Figure 4).

An index of relative urbanization in the area is the population density. Minnehaha County with 117 persons per square mile is the most dense because of Sioux Falls. The other five counties, which are predominantly rural, have densities ranging from 12 to 26 persons per square mile (Figure 5).

Another index that indicates the degree of urbanization is the percentage of land in farms. By this measure, Metropolitan Sioux Falls counties are predominantly rural, ranging from 93.7 percent in Minnehaha County to 97.6 percent in McCook County (Table II).

A comprehensive plan[1/] was recently completed for the Greater Sioux Falls Regional Planning Commission. The plan was based on an area that included the townships of Sioux Falls, Wayne, Brandon and Split Rock in Minnehaha County and the townships of DeLapre and Springdale in Lincoln County (Figure 6).

It was stated in the Regional Plan that there were 25,000 dwelling units located within the eight township region. Of these, 88 percent were within the corporate limits; 3 percent in

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1/ Harland Bartholomew & Associates, A Comprehensive Plan for the Greater Sioux Falls Region, October, 1969.

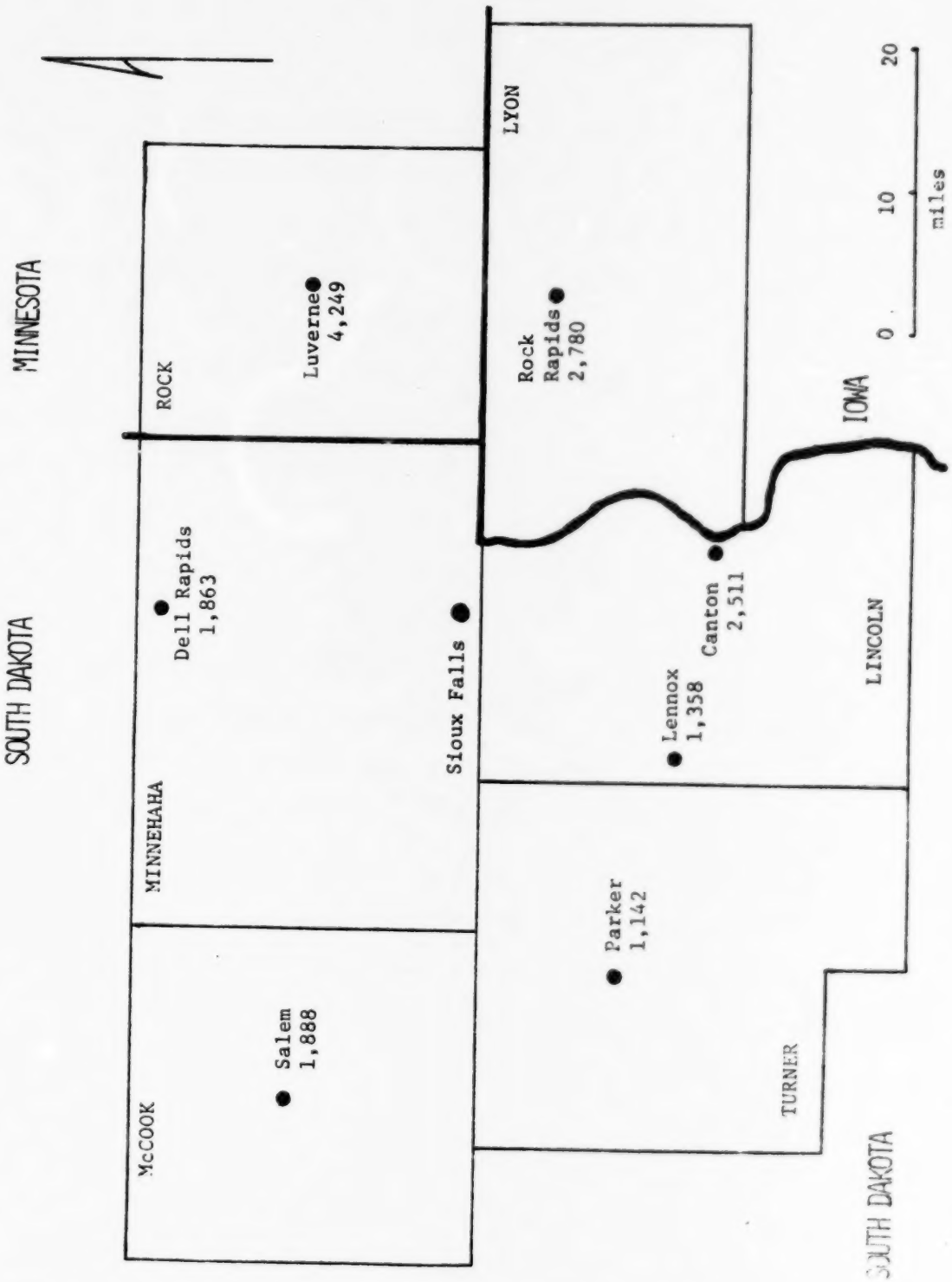

FIGURE 4 - Population of Towns in Outlying Locations of Metropolitan Sioux Falls Area

Source: Population estimates are those of Rand McNally Corporation.

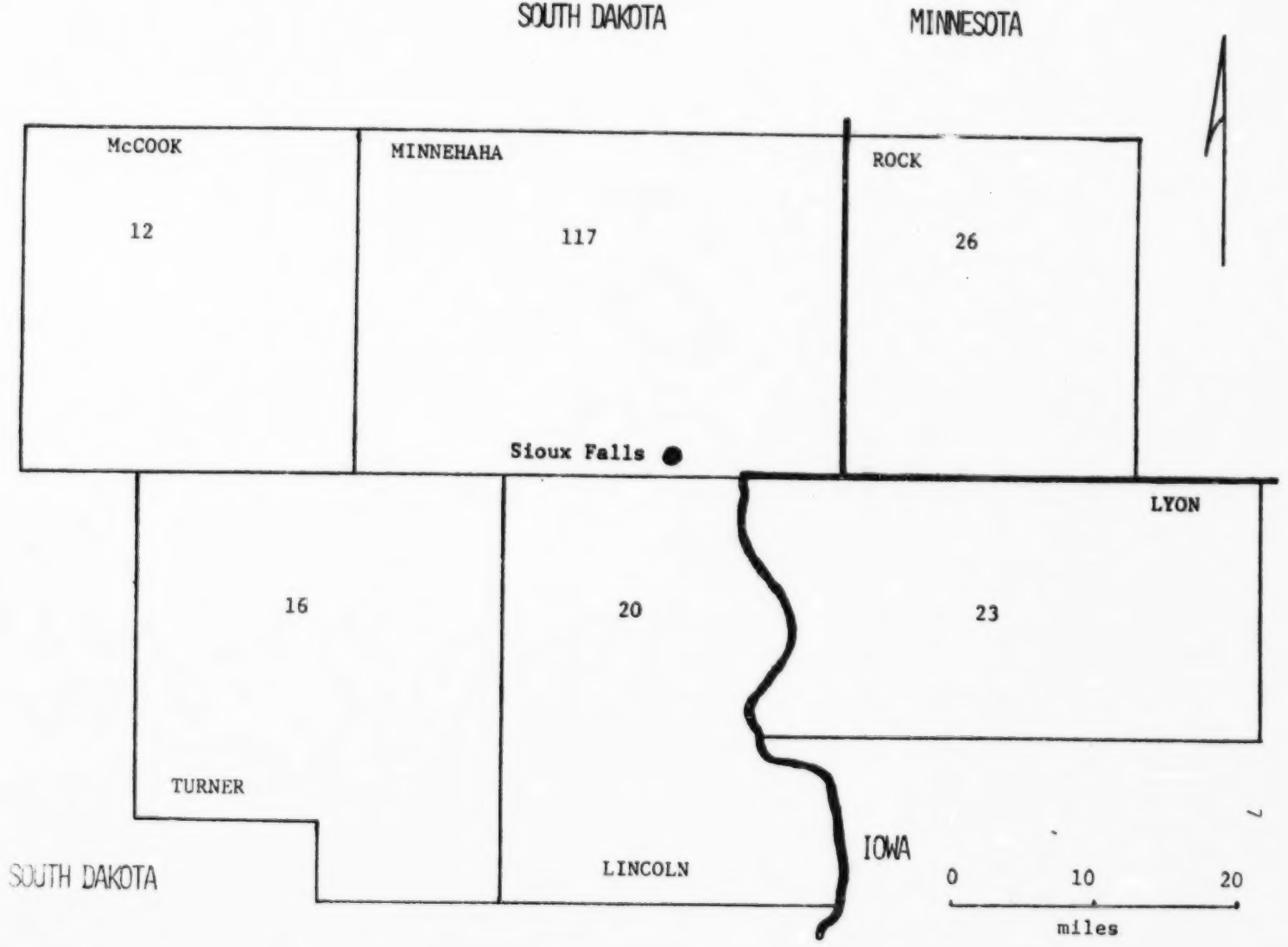

FIGURE 5 - Population Per Square Mile of Metropolitan Sioux Falls Area Counties, 1968

Table II

Total Land Area and Percent of Area in Farms, Metropolitan Sioux Falls Area Counties

Counties	Total Land Area (Sq. miles)	Percent, Area in Farms, 1964
Sioux Falls SMSA:		
Minnehaha (S. Dakota)	813	93.8
Adjoining Counties:		
Lincoln (S. Dakota)	576	97.3
McCook (S. Dakota)	575	97.6
Turner (S. Dakota)	612	97.2
Lyon (Iowa)	588	96.7
Rock (Minnesota)	485	96.4

Source: U.S. Department of Commerce, Bureau of the Census, County and City Data Book, 1967.

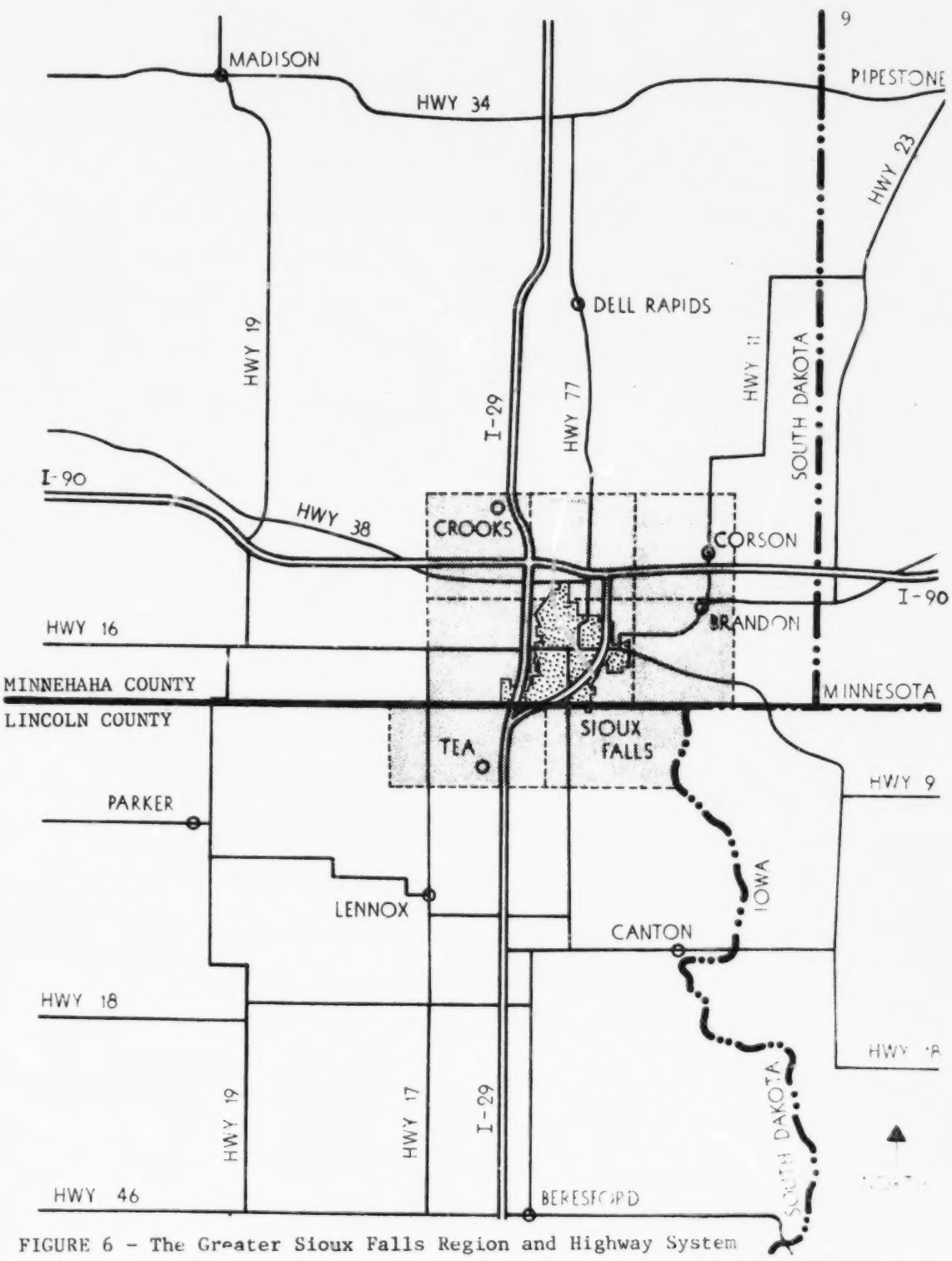

FIGURE 6 - The Greater Sioux Falls Region and Highway System

Source: Harland Bartholomew & Associates, A Comprehensive Plan for the Greater Sioux Falls Region, October, 1969

the various unincorporated towns and villages; and the remaining 9 percent in the rural and urban fringe areas.

Sioux Falls is unique, in one sense, compared with most other metropolitan cities, in that practically all the urbanized area is within the city limits. The closest town of over 1,000 persons is fifteen miles distant.

Between 1950 and 1960, the State of South Dakota declined in total employment by 1.6 percent due primarily to the nation-wide trend of a decline in agricultural employment. During this same period, however, Minnehaha County (or the Sioux Falls SMSA) increased in employment by 10.3 percent due to the industrial growth of Sioux Falls.

Most of the manufacturing firms in Sioux Falls are agriculturally oriented, and their marketing area includes the six counties in the Sioux Falls study area. They can be categorized as light and diversified. Some of the principal types of industries are: meat packing, metal fabrication, feed mills, food and kindred products, and wood and concrete products. There are two electric generating plants in the study area.

In 1968, employment in the City of Sioux Falls was estimated at 32,000. The regional total was 35,700 (Table III). Manufacturing accounted for the largest percentage of employment in both the city and region. For the rural areas of the region (parts of Minnehaha and Lincoln counties), agricultural employment

Table III

Estimated Employment Distribution - 1968

Category	City of Sioux Falls		Minnehaha County (Part)*		Lincoln County (Part)**		Total Sioux Falls Region	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Manufacturing	6,750	21.1	350	11.3	85	14.2	7,185	20.1
Retail Trade	6,200	19.4	330	10.7	70	11.7	6,600	18.5
Government	4,250	13.3	150	4.8	15	2.5	4,415	12.4
Professional Services	3,100	9.7	150	4.8	20	3.3	3,270	9.1
Other Services	2,150	6.7	230	7.4	55	9.2	2,435	6.8
Transportation, Communication, and Utilities	2,900	9.0	170	5.5	20	3.3	3,090	8.7
Wholesale Trade	2,850	8.9	125	4.0	25	4.2	3,000	8.4
Finance, Insurance, Real Estate	2,100	6.5	60	1.9	10	1.6	2,170	6.1
Construction	1,300	4.1	200	6.5	25	4.2	1,525	4.3
Agriculture	180	0.6	1,180	38.1	250	41.6	1,610	4.5
Other	220	0.7	155	5.0	25	4.2	400	1.1
Total	32,000	100.0	3,100	100.0	600	100.0	35,700	100.0

* Includes the townships of Benton, Brandon, Mapleton, Sioux Falls, Split Rock and Wayne, excluding the City of Sioux Falls.

** Includes the townships of De Lapre and Springdale.

Source: Estimates by Harland Bartholomew and Associates, 1968.

predominates, representing nearly two-fifths of the total rural employment force. Other important employment groups are retail trade, services, and government. Together, they represent nearly one-half of the total employment force for both Sioux Falls and the region as a whole.

Although agricultural employment has dropped in the last decade in Sioux Falls as urbanized types of employment have increased, farming remains an important element of the region's economy. Farming income in the regional area is high compared to similar types of income in other areas of South Dakota. Sioux Falls is the trading area for this rich farm region, and thus benefits from the high income levels as evidenced by the favorable retail sales statistics.

PROSPECTIVE POPULATION AND ECONOMIC GROWTH

Table IV shows the past population figures and the future population estimates of the Greater Sioux Falls Region. The population projections shown in the Minnehaha County and Lincoln County Comprehensive Plans confirm the projections shown in Table IV. The total population for the counties of Lyon, McCook, Rock and Turner is expected to decline.

Employment estimates for the Greater Sioux Falls Region show an increase from 35,700 in 1968 to 60,000 in 1990 (Table V). The major increase is expected in manufacturing (77 percent). Retail trade employment will increase to 11,300 persons by 1990, while professional and other services will increase to 9,950 persons.

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Table IV

Past and Future Population of the Greater Sioux Falls Region

Year	Population	Percent Decade Change
1940	45,880	-
1950	58,992	+28.6
1960	75,965	+28.8
1968	93,000	--
1970	95,000	+25.1
1980	125,000	+25.0
1990	150,000	+25.0

Sources: U. S. Census of Population, 1960;

Estimates by Harland Bartholomew and Associates, 1968

Table V

Greater Sioux Falls Regional Area
Employment Projection

Category	1968 Number	1968 Percent	1990 Number	1990 Percent
Manufacturing	7,185	20.1	12,750	21.2
Retail Trade	6,600	18.5	11,300	18.8
Government	4,415	12.4	6,550	10.9
Professional Services	3,270	9.1	5,650	9.4
Other Services	2,435	6.8	4,300	7.2
Transportation, Communication, and Utilities	3,090	8.7	5,050	8.4
Wholesale Trade	3,000	8.4	5,500	9.2
Finance, Insurance, Real Estate	2,170	6.1	3,700	6.2
Construction	1,525	4.3	2,500	4.2
Agriculture	1,610	4.5	900	1.5
Other	400	1.1	1,800	3.0
Total	35,700	100.0	60,000	100.0

Source: Harland Bartholomew & Associates, A Comprehensive Plan for the Greater Sioux Falls Region, October, 1969

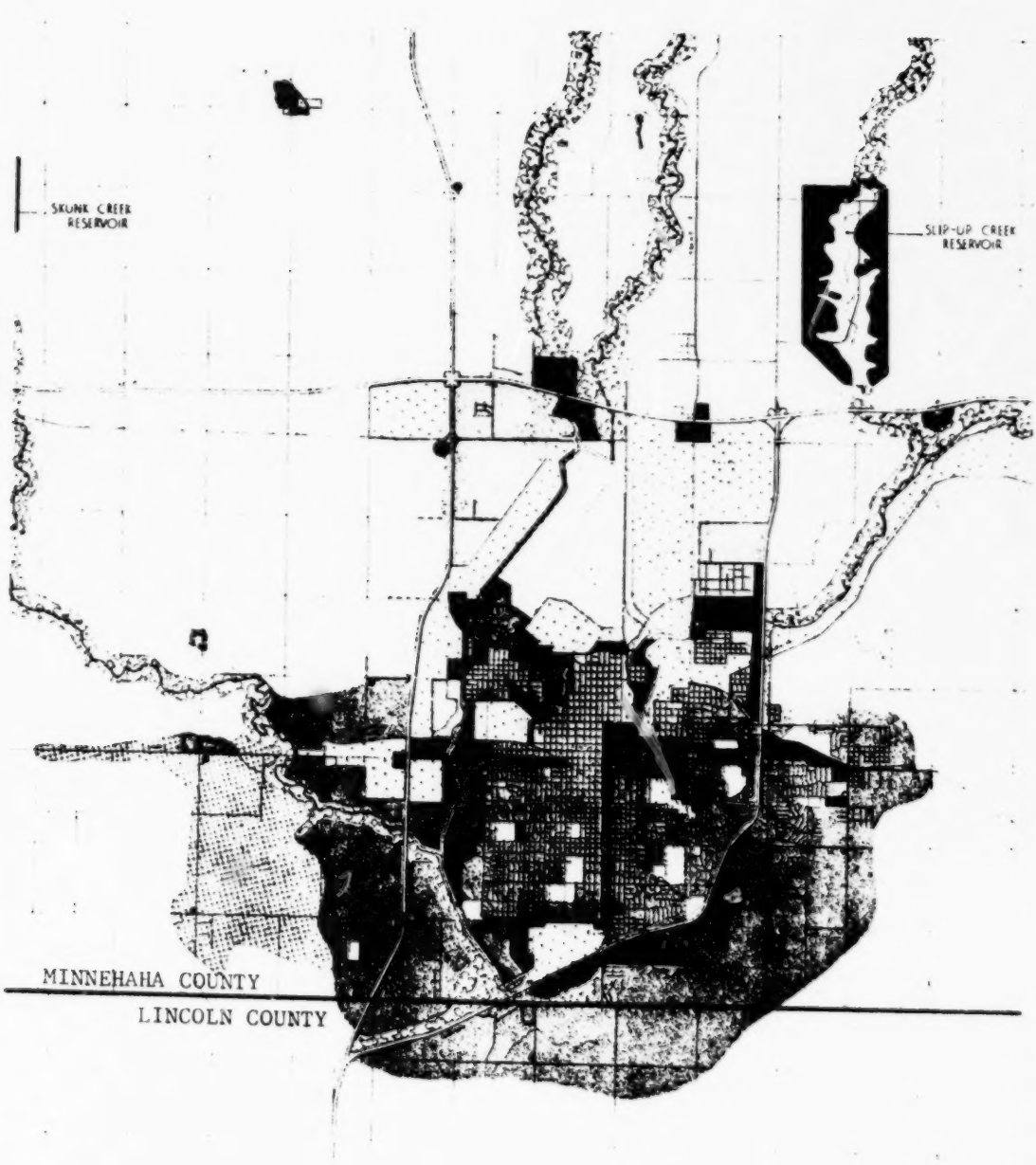
The additional employment force (24,300 workers) plus the existing employment force of 35,700 workers would make a total employment force of 60,000 workers. These 60,000 workers plus their dependents (2.5 per worker) would give the Greater Sioux Falls Region a 1990 population of 150,000 persons.[2/]

PROBABLE DIRECTIONS OF PHYSICAL GROWTH

If the policies in the Regional Plan are followed, the major residential growth (Figure 7) will occur at the southern edge of Sioux Falls spilling over into Lincoln County and also will extend around to the southwest and southeast of the present city limits. There is a ridge line cutting diagonally across the southeastern quadrant of the Sioux Falls urban area beyond which any further extensive urban development would require the construction of a separate sewage treatment plant or the provision of suitable lift stations. The Regional Plan suggests more dense residential development in the central Sioux Falls urban area. The hilly terrain to the northeast will effect slower rate of growth and the resulting development will be of much lower density than that found in other sections of the urban area.

The area planned for industrial development is north of Sioux Falls, adjacent to Highway 77 and Interstate 90. This area can easily be served with public water and sanitary sewers and it has very good access to the major highway system. Rail

2/ Ibid.



Residential (urban density)

Industrial

Residential (rural density)

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FIGURE 7 - Future Residential and Industrial Growth through 19[illegible]

Source: Harland Bartholomew & Associates, A Comprehensive Plan [illegible] the Greater Sioux Falls Region, October, 1969

service can be provided from the Chicago, Milwaukee, St. Paul and Pacific main line, which runs along the eastern edge of Joe Foss Field.

Additional planned industrial areas related to Interstate 90 are further to the east and west of Highway 77. The eastern area lies between the Chicago and Northwestern and Great Northern railroad tracks and has reasonably good access to the interstate highway. The industrial area to the west is located next to the Interstate 29-90 interchange and has ready access to both interstate routes via State Highway 38.

The Interstate Highway System (Figure 6 above) in the metropolitan Sioux Falls area is completed and provides an ideal basis for expansion.

From a study of the rural counties in the study area (excluding Minnehaha) it is apparent that the population is declining like that in most agricultural counties in the United States. The one exception is Lyon County in Iowa, which had a 4.2 percent increase from 1960 to 1970. The total population was 59,670 in 1950 and is estimated today to be 54,522. There is no evidence of any rapid urban expansion.

One conclusion to be drawn from this analysis of the urban factors of the Sioux Falls study area is that all growth expected in the foreseeable future will be confined primarily to Sioux Falls and its immediate environs. Most of this growth will be in Minnehaha County and extending into the extreme northern part of

Lincoln County to the south. As previously noted no rural growth is expected.

Another conclusion of equal importance is the fact that the entire study area is economically related to the City of Sioux Falls. All six counties are included in the Sioux Falls Basic Trading Area.[3/] Most of the area's goods and services are purchased and the area's agricultural production marketed in Sioux Falls. Sioux Falls is also the center for such activities as medical care, education and entertainment.

This cohesive relationship of the rural counties to the central city lends itself to considering the six county study area as an integral unit. The transportation network, both rail and highway, is oriented to support this relationship.

3/ Rand McNally & Company, 1970 Commercial Atlas and Marketing

EVALUATION OF TECHNICAL FACTORS

The technical factors of importance in considering the boundaries of an air quality control region are:

1. The total quantity of pollutants emitted;
2. the geographic pattern of emissions sources; and
3. patterns of pollutant dispersion.

By relating these technical factors to urban factors described above, it is possible to evaluate both pollution sources and people and property affected by the sources.

In the Sioux Falls study area, information with respect to technical factors was obtained from an emission inventory conducted by the National Air Pollution Control Administration (NAPCA), and data obtained from the National Air Sampling Network.

THE EMISSION INVENTORY

The emission inventory, based on 1968 data, includes estimates from a six-county interstate area surrounding the city of Sioux Falls, South Dakota (Lincoln, McCook, Minnehaha and Turner Counties in South Dakota, Lyon County in Iowa, and Rock County in Minnesota).

The NAPCA emission inventory is available as a separate publication.[4/] Significant findings are summarized here.

[4/] U.S. Department of Health, Education and Welfare, Public Health Service, Environmental Health Serivce, National Air Pollution Control Administration, Durham, North Carolina, March 1970. Sioux Falls Metropolitan Area Air Pollutant Emission Inventory Report.

Methodology

The quantity of emissions in the study area was estimated individually for point sources and areawide for other sources by use of a survey technique developed by the Public Health Service.[5/] Facilities which emit large quantities of pollutants were identified individually as point sources, while contributors such as motor vehicles, residential and commercial fuel users, small industries, and on-site refuse burning, were considered collectively as one source.

Emission estimates were obtained by applying average emission factors[6/] to indicators of pollutant emissions such as production data or type of fuel burned. Because these are average factors, estimates from a specific sources may vary from its actual emissions, but total estimates are likely to approximate actual conditions as the variances cancel out.

Geographic distribution of the emissions was determined by apportioning the estimated point and area source emissions to their respective counties (Figure 8 and Table VI).

5/ Public Health Service, Rapid Survey Technique for Estimating Community Air Pollution Emissions. Publication No. 999-AP-29, Envirnomental Health Series, U.S.D.H.E.W., Division of Air Pollution, Cincinnati, Ohio, 1966.

6/ Public Health Service, Compilation of Air Pollutant Emissions Factors. Publication No. 999-AP-42, Environmental Health Series, U.S.D.H.E.W., NAPCA, Durham, North Carolina.

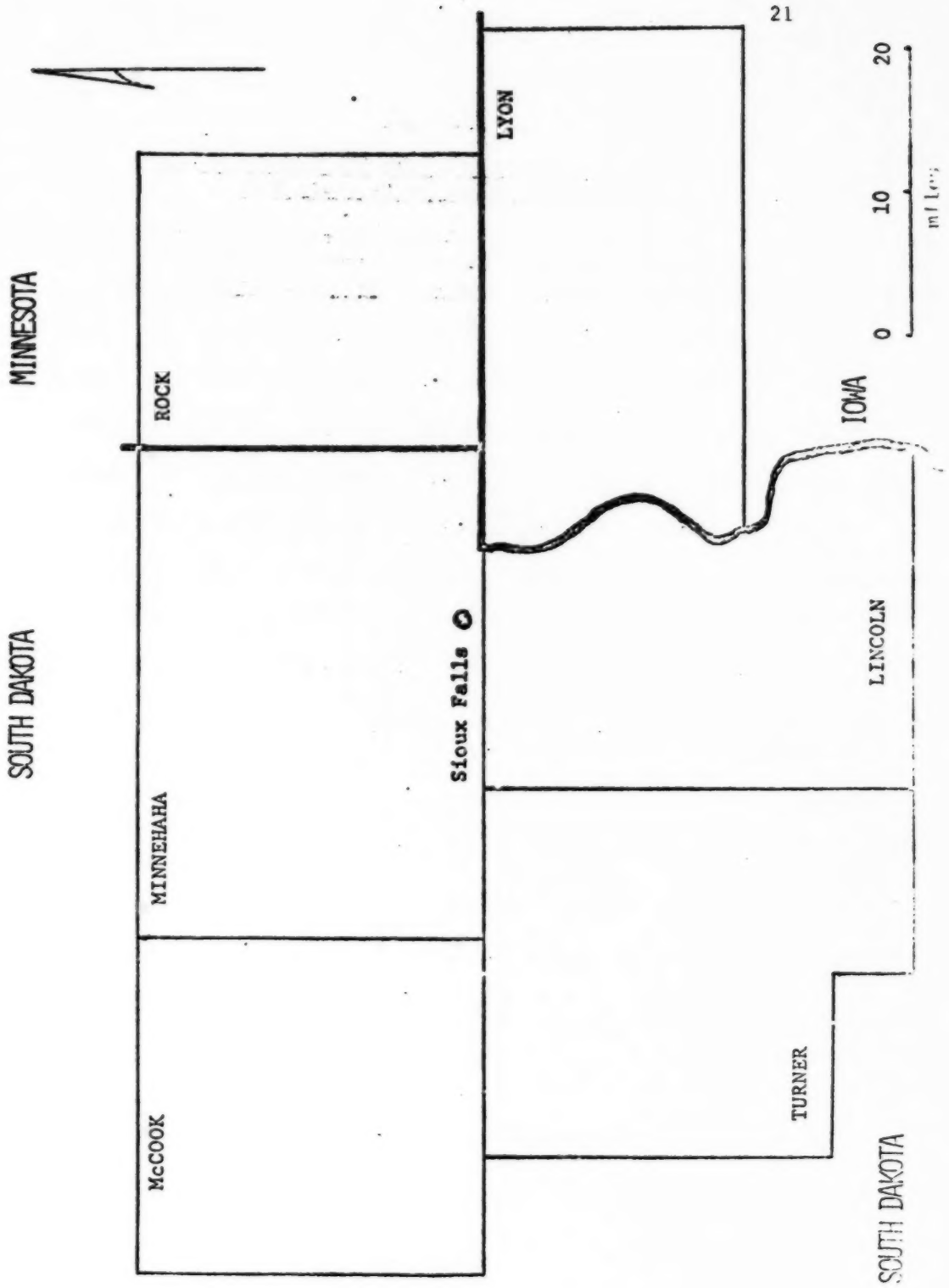


FIGURE 8. COUNTIES IN METROPOLITAN SIOUX FALLS STUDY AREA INVOLVED IN EMISSIONS INVENTORY.

Table VI

Air Pollutant Emissions From All Sources in the Metropolitan Sioux Falls Study Area

(Annual Average Tons Per Day Per Square Mile)

County	Land Area (Sq. Mi.)	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Lincoln	576	0.18	0.29	17.00	3.34	1.62
Lyon	588	0.17	0.25	12.08	2.76	1.31
McCook	575	0.098	0.15	9.09	1.88	0.89
Minnehaha	813	4.01	5.17	80.5	17.00	8.30
Rock	485	0.15	0.25	12.47	2.77	1.33
Turner	612	0.093	0.14	6.04	1.56	0.73

Five pollutants were inventoried: sulfur oxides, particulates, carbon monoxide, hydrocarbons, and nitrogen oxides. The emissions were estimated for five categories of source: transportation, stationary fuel consumption, solid waste disposal, industrial processes, and evaporation losses.

Summary of Results

From data obtained by the inventory, the following summary was derived:

Sulfur Oxides — The largest portion of the sulfur oxides emitted in the Study Area came from one individual source, a steam-electric utility in Minnehaha County, which emitted approximately 61 percent of the total sulfur oxides. Three other sources, transportation, industries and residences, emitted over 38 percent of the total sulfur oxides. This can easily be explained since the steam-electric plant and industry consumed over 99 percent of all the coal utilized by all sources. The remaining individual sources together with the area sources emitted less than one percent of the 3,660 tons of sulfur oxides.

Particulates — As in the case of sulfur oxides, the steam-electric utility in Minnehaha County contributed

over 50 percent of the total particulates emitted. Transportation was the next largest contributor emitting an additional 24 percent. Refuse disposal, the third largest contributor, emitted approximately 15 percent of the total. The remaining individual sources together with the area sources emitted only 11 percent of the 4,823 tons of particulates.

Carbon Monoxide

Road vehicles contributed 90 percent of the carbon monoxide emitted annually. The other main source is solid waste disposal which accounted for 9 percent of total emissions.

Hydrocarbons

The three largest sources of the 20,725 tons of hydrocarbons were refuse disposal, road vehicles, and evaporation losses. They contributed 38 percent, 35 percent, and 25 percent, respectively, of total hydrocarbon emissions. Most of the remaining 2 percent was divided among aircraft, railroads, and residential heating losses.

Nitrogen Oxides

The three sources of nitrogen oxides were transportation, refuse disposal, and stationary fuel combustion, which accounted for 62 percent, 21 percent, and 17 percent respectively.

Table VII summarizes the estimated quantities of pollutants by source. Emissions by county and source are shown in Table VIII, and the percentage contribution by county are shown in Table IX. Figure 9 indicates the location on the County map of the inventoried point sources, and both point and area source estimates were combined and attributed to the counties zones to produce density maps (Figures 10a, 10b, 10c, 10d, and 10e).

AIR QUALITY ANALYSIS

The boundaries of an air quality control region should be drawn to include both pollution sources and people and property affected. The inventory identifies pollution sources in the study area, but does not provide information about people and property affected. The atmospheric distribution of pollutants from the sources should be determined in order to satisfy this requirement.

The best way to do this is to review air quality sampling data over time at sufficient points to provide an adequate pattern from measured data.

Air Sampling Data

Data obtained from the National Air Surveillance Network station at Sioux Falls with respect to suspended particulates for the years 1957-1968 are presented in Table X.

Table VII

Summary of Air Pollutant Emissions in the Metropolitan Sioux Falls Study Area, 1968

(tons per year)

Source	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Transportation	(577)	(1,178)	(88,064)	(7,567)	(6,262)
Road Vehicles	477	823	87,643	7,167	5,645
Other Vehicles	99	355	421	400	617
Fuel Combustion	(3,038)	(2,870)	(33)	(38)	(1,711)
Industrial	442	177	4	2	232
Power Generation	2,277	2,521	6	6	780
Residential	288	136	19	27	503
Commercial and Institutional	29	35	2	2	194
Refuse Disposal	(45)	(774)	(9,118)	(7,961)	(2,081)
Incineration	0	0	0	0	0
Open Burning	45	774	9,118	7,961	2,081
Industrial Process Losses	0	0	0	0	0
Evaporation Losses	--	--	--	5,158	--
Total Emissions	3,660	4,823	97,216	20,725	10,055

Table VIII

Air Pollutant Emissions in the Metropolitan Sioux Falls Study Area by Emissions Sources and by County, 1968

(tons per year)

	County *	FUEL COMBUSTION					Industrial Process Losses	Transportation	Refuse Disposal	Grand Total[a/]
		Industrial	Institutional	Residential	Power Plants	Total Fuel Combustion				
Particulates	Lincoln (S.D.)	0	4	11	0	15	0	125	25	170
	McCook (S.D.)	0	2	7	0	10	0	65	12	90
	Minnehaha (S.D.)	177	15	79	2,521	2,793	0	748	665	4,200
	Rock (Minn.	0	3	11	0	15	0	84	24	110
	Lyon (Iowa)	0	4	15	0	20	0	100	28	150
Sulfur Oxides	Lincoln (S.D.)	0	5	27	0	33	0	68	1	100
	McCook (S.D.)	0	4	17	0	21	0	35	0	60
	Minnehaha (S.D.)	442	3	151	2,277	2,875	0	349	39	3,260
	Rock (Minn.)	0	5	24	0	30	0	44	1	75
	Lyon (Iowa)	0	6	40	0	46	0	52	1	100
Carbon Monoxide	Lincoln (S.D.)	0	0	1	0	2	0	9,317	449	9,770
	McCook (S.D.)	0	0	1	0	1	0	4,941	280	5,220
	Minnehaha (S.D.)	4	0	10	6	22	0	58,350	7,010	65,380
	Rock (Minn.)	0	0	1	0	2	0	5,604	439	6,045
	Lyon (Iowa)	0	0	2	0	3	0	6,535	551	7,090

a/ Totals have been rounded

* No figures available for Turner County, S.D.

Table IX

Percentage Contribution of Each County to the Total Air Pollutant Emission

County	Sulfur Oxides	Particulates	Carbon Monoxide	Hydrocarbons	Nitrogen Oxides
Lincoln (S.D.)	2.8	3.5	10.1	9.3	9.3
Lyon (Iowa)	2.7	2.8	7.2	7.2	7.6
McCook (S.D.)	1.5	1.8	5.4	5.2	5.1
Minnehaha (S.D.)	89.3	87.5	67.3	66.6	67.2
Rock (Minn.)	2.1	2.6	6.2	6.5	6.4
Turner (S.D.)	1.6	1.8	3.8	4.6	4.4

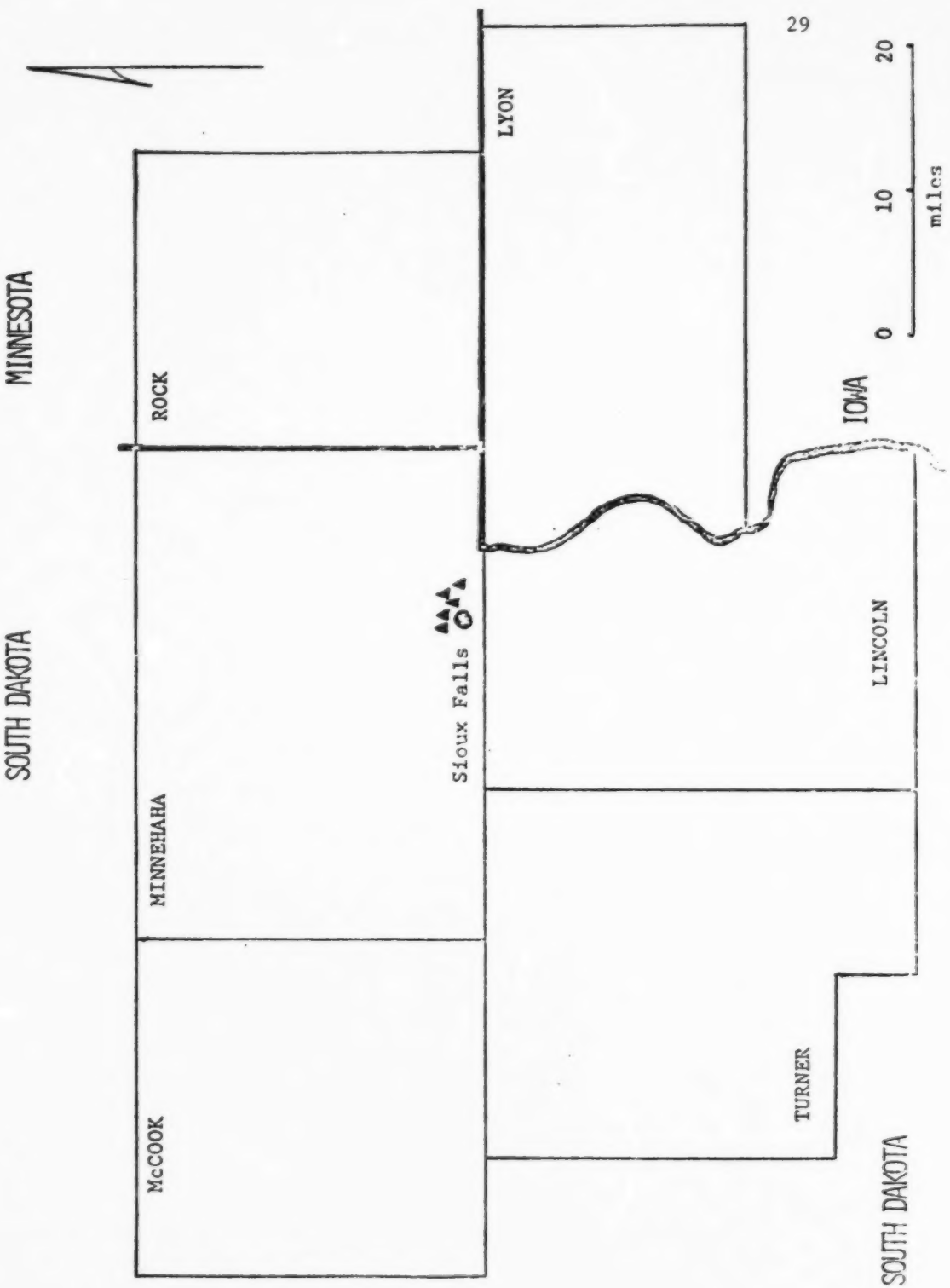


FIGURE 9. POINT SOURCE LOCATIONS FOR THE METROPOLITAN SIOUX FALLS STUDY AREA

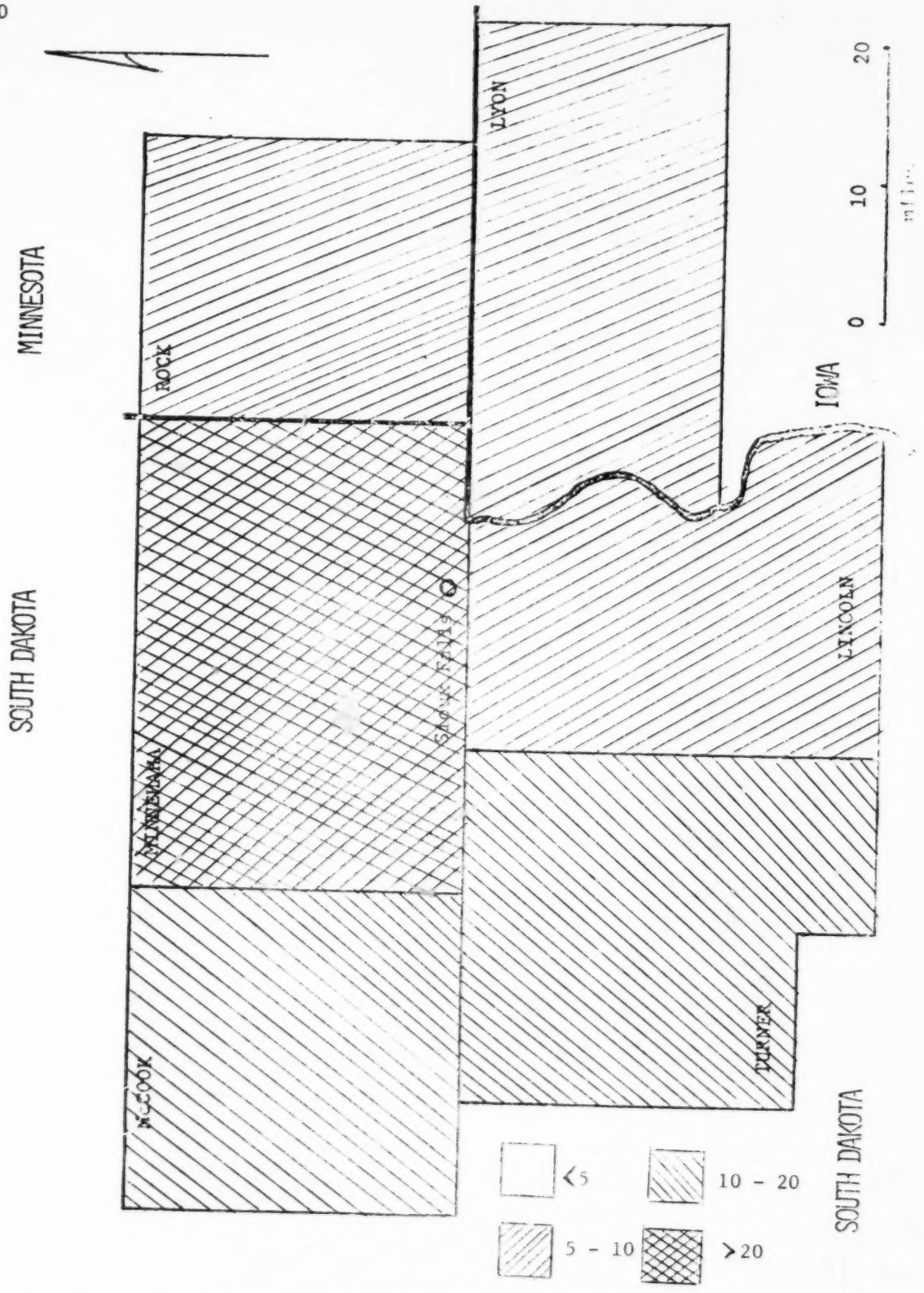


FIGURE 10c. COUNTY EMISSIONS DENSITIES FROM ALL SOURCES FOR CARBON MONOXIDE IN TONS/YEAR SQ. MILE

FIGURE 10b. COUNTY EMISSION DENSITIES FROM ALL SOURCES FOR PARTICULATES IN TONS/YEAR SQ. MILE

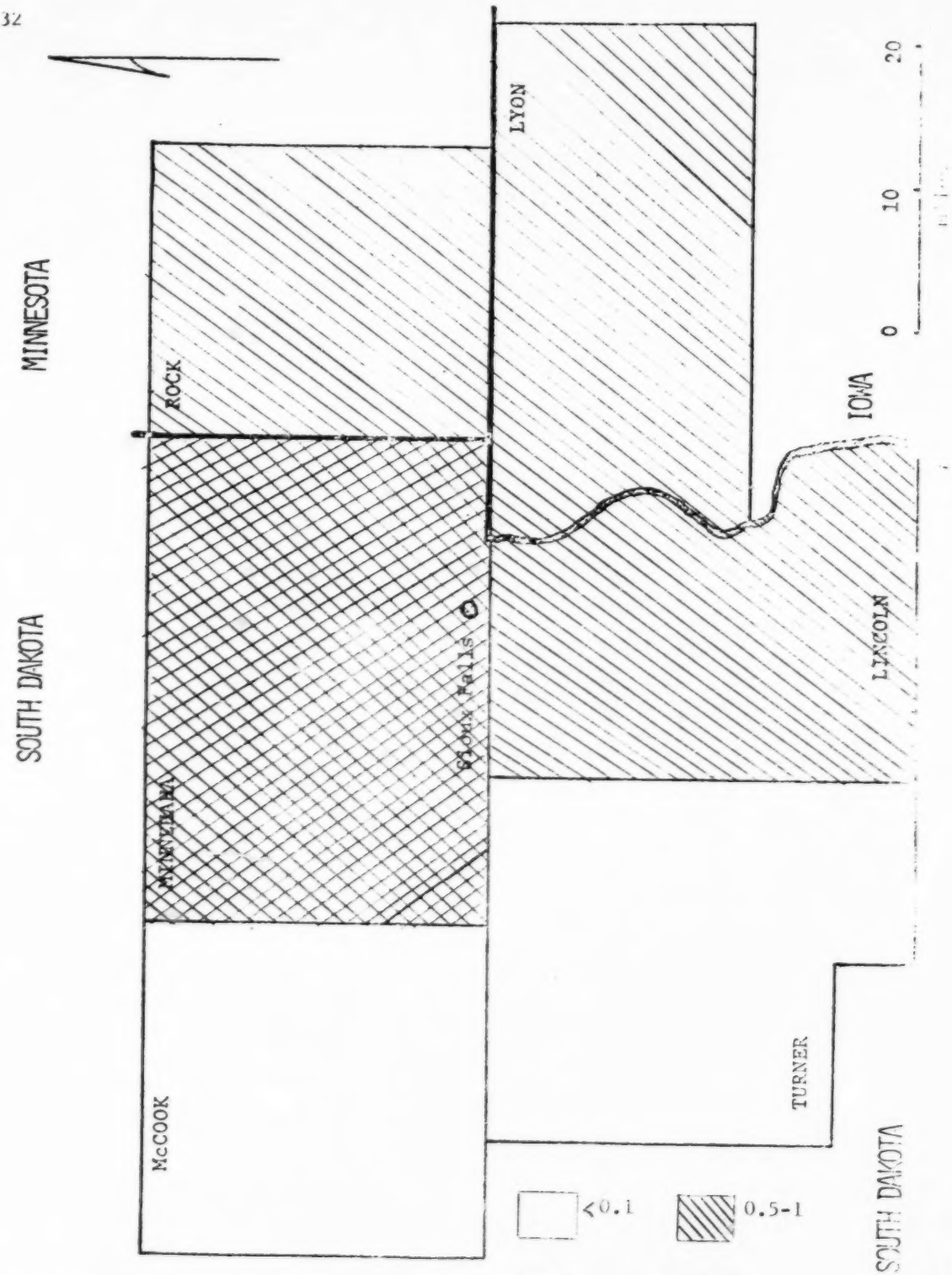


FIGURE 10a COUNTY EMISSION DENSITIES FROM ALL SOURCES FOR SULFUR OXIDES IN TONS/YEAR SQ. MILE

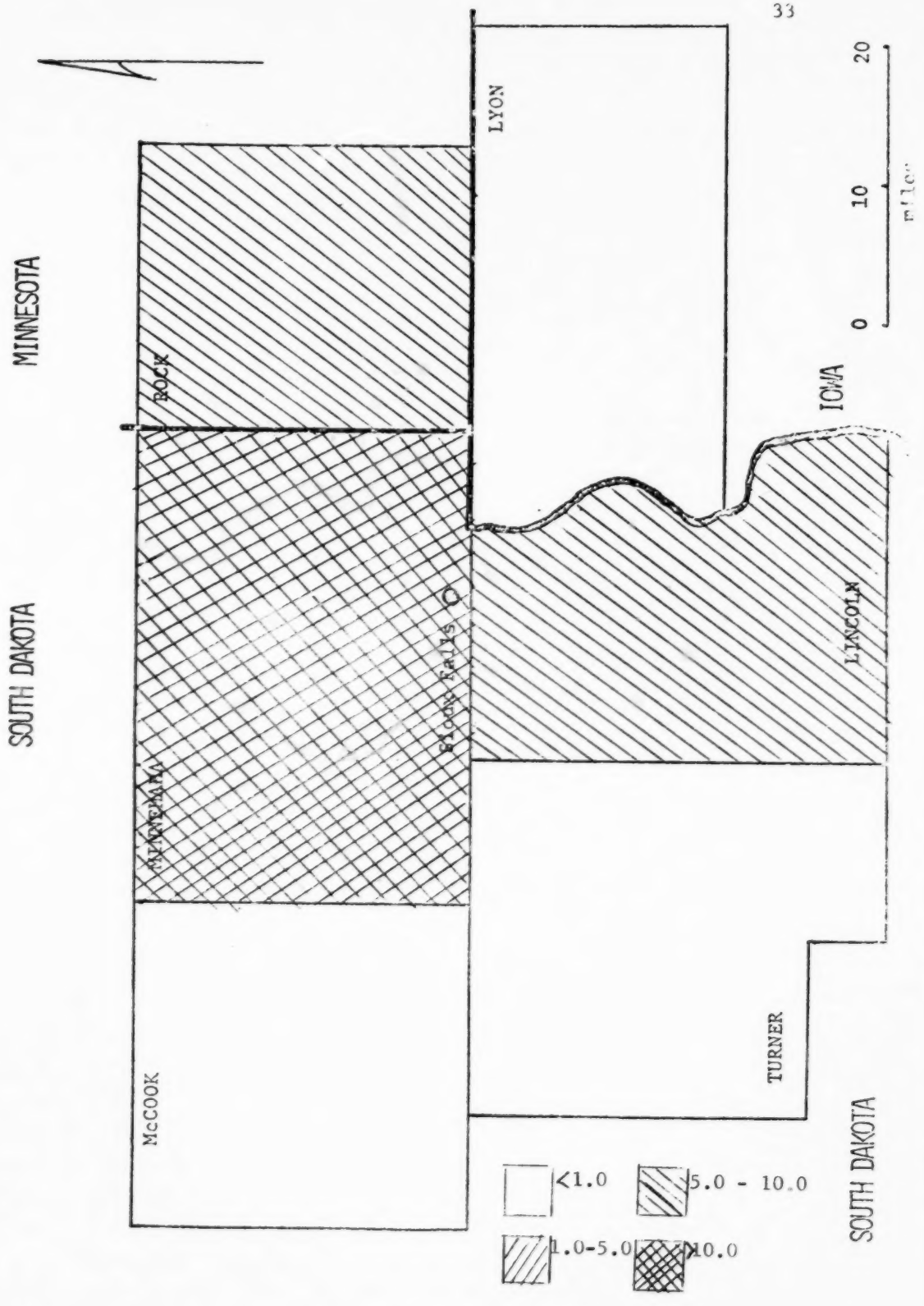


FIGURE 10d. COUNTY EMISSION DENSITIES FROM ALL SOURCES FOR HYDROCARBONS IN TONS/YEAR SQ. MILE

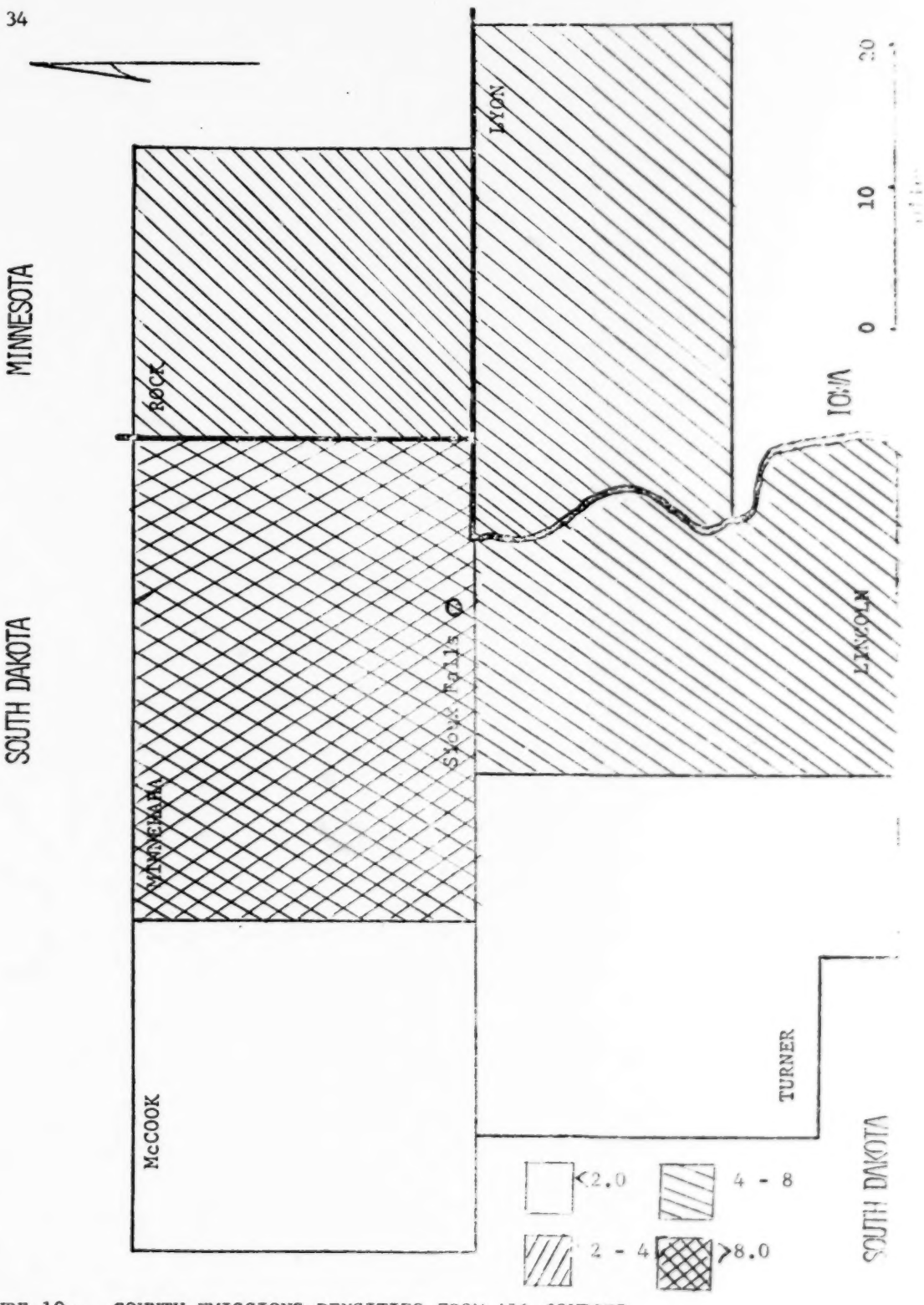


FIGURE 10e. COUNTY EMISSIONS DENSITIES FROM ALL SOURCES FOR HYDROCARBONS IN TONS/YEAR SQ. MILE

Table X

Yearly Average Values of Suspended Particulates
for Sioux Falls, South Dakota

Year	Number of Samples	Geometric Mean Value (micrograms per cubic meter)
1957	47	86
1958	25	106
1959	26	83
1960	22	87
1961	26	57
1962	23	80
1963	23	57
1964	25	79
1965	26	55
1966	26	57
1968	23	55
1957-68	292	73

Source: National Air Surveillance Network, Data Systems Section, 1969.

Fuel Consumption

The types of fuel consumed in the Sioux Falls study area are coal, oil (distillate and residual) and natural gas.

A summary of fuels consumed by various users follows:

Coal — In 1968 the Sioux Falls study area consumed 27,910 tons of coal. The county of Minnehaha consumed the entire amount. One electric generating plant was the principal user (87%) while industry in the county consumed the remaining 13%.

Oil (distillate) — The total amount of this type of oil consumed in the six counties of the study area in 1968 was 20,135,000 gallons. Of this amount, 89% was used for residential heating, 10% by commercial businesses and the balance by industries.

Oil (residual) — In 1968 the Sioux Falls study area consumed 4,423,000 gallons of this type of oil. The county of Minnehaha consumed the entire amount. An electric generating plant used 52 % of the total and industry used the balance of 48%.

Natural Gas — In 1968 the Sioux Falls study area used slightly over twelve trillion cubic feet of natural gas. All six counties consumed part of the total. Residential heating used 57% of the total; commercial business, 17%; electric generation, 16%; and industry, 10%.

Meteorology

The Sioux Falls area is located in the Big Sioux River Valley where the terrain is relatively flat and open. Southerly winds prevail in the summer, while during the fall and in winter the air flow is from the northwest (Figure 11). Winds average between eleven and twelve miles per hour and with the flat terrain and few ground obstructions provide good ventilation in the study area. Calm days occur on the average of only 3.2 percent of the time--about 12 days out of a year. This fact coupled with the absence of prolonged inversions and relatively strong winds prevents accumulation of air pollutants. Useful indicators of this condition are the morning and afternoon seasonal air mixing depths for the Sioux Falls area, presented in Table XI. These mixing depths provide a measure of the volume within which pollutants may mix without restriction.

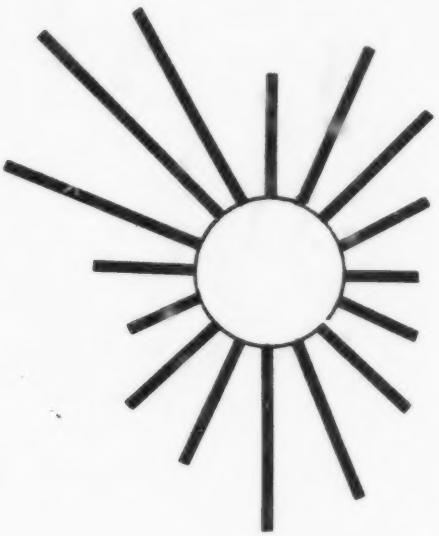
Table XI

Air Mixing Depths

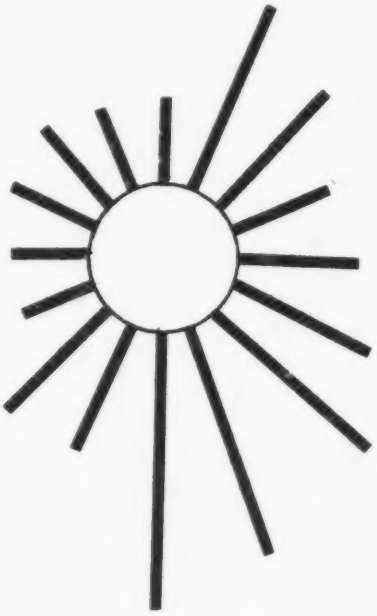
(meters)

	Winter	Summer	Annual
Morning	240	340	305
Afternoon	620	1,700	1,245
Average	430	1,020	775

WINTER

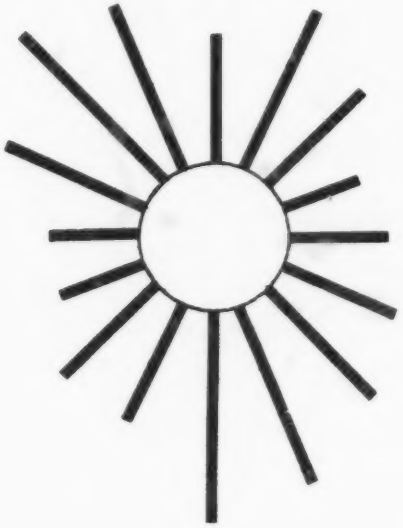


SUMMER



ANNUAL

(Includes All Four Averaging Periods)



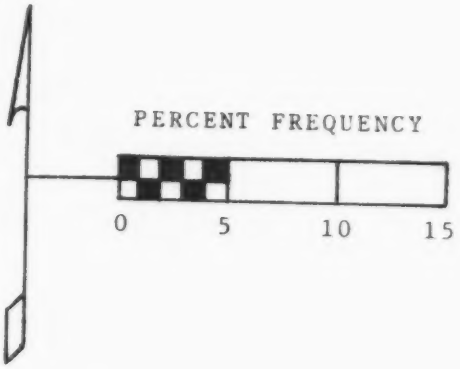


FIGURE 11- Wind Direction Percent Frequency of Occurrence for Various Averaging Times

Conclusion

Analysis of the emission inventory, air sampling, and meteorology indicate that pollutant concentrations are highest in the immediate Sioux Falls Area.

REGIONAL GOVERNMENTAL ORGANIZATION

Regional Planning Body

The Greater Sioux Falls Regional Planning Commission, established in August, 1967, has planning responsibility for six townships in Minnehaha County (Sioux Falls, Wayne, Benton, Mapleton, Brandon and Split Rock) and two townships in Lincoln County (DeLapre and Springdale). The Commission's past activities include physical development planning (housing, highways, water and sewer facilities), human resources planning (education, health, welfare) and natural resources planning. Its major area of emphasis at present is housing.

Metropolitan Clearinghouses

In accordance with the Intergovernmental Cooperation Act of 1968 the Greater Sioux Falls Regional Planning Commission has been designated as a Metropolitan Clearinghouse. Through the clearinghouse, Federal development assistance is coordinated with State, regional and local comprehensive planning. As a clearinghouse, the Commission is responsible for review of project proposals and applications for Federal assistance submitted by localities within its planning jurisdiction.

Cooperative Area Manpower Planning System Area

The Federal Cooperative Area Manpower Planning System (CAMPS) provides for committees to coordinate the planning

of all manpower programs in a particular area. In January, 1969, the South Dakota state CAMPS coordinating committee established area committees. One of these area CAMPS committees is responsible for coordinating manpower activities for a six county area including Minnehaha, Lincoln, McCook, Turner, Clay and Union Counties.

State Planning Districts

The South Dakota State Planning Department is just beginning to divide the State into state planning districts for comprehensive planning purposes. These districts, which will generally coincide with the existing CAMPS areas, will be officially designated by the Governor in an executive order. The counties will then be given a year in which they can express a desire to become a part of another planning district if they so choose.

Areawide Comprehensive Health Planning Districts

The Public Health Service provides grants to local governmental organizations for areawide comprehensive health planning. The planning areas should have a population of sufficient size so that a full range of physical, mental and environmental health services, facilities and manpower is or can be available within the area. This means that in some cases rural territories may have to associate with urban areas in conducting a comprehensive health planning program. In the Sioux Falls metropolitan area, an areawide

comprehensive health planning organization is in the process of being created. This organization's jurisdiction--as presently being discussed-would include the following seven counties: Minnehaha, Lincoln, McCook and Turner Counties in South Dakota, Lyons County in Iowa and Rock and Pipestone Counties in Minnesota.

Air Pollution Control Organizations

In 1961, the South Dakota Legislative Research Council requested the State Department of Health to conduct a statewide air pollution survey. A major recommendation resulting from that survey was that the primary responsibility for air pollution prevention and control should rest with the local government. Recommended legislation would authorize the State, in the organization of the State Department of Health, to provide substantial assistance to local governments in establishing and operating air pollution control programs. To date no State or local air pollution agencies or programs have been established.

The Iowa Air Pollution Control Act (1967) created an Air Pollution Control Commission within the State Department of Health. It provides for broad State powers and enables the establishment of local programs.

The State of Iowa's current annual budget for its air pollution control program is $100,000, consisting entirely of

State funds. One full-time engineer and part-time specialists in the State Hygienic Laboratory assist the director of the program.

The Minnesota Pollution Control Agency has responsibility for air pollution control within the State of Minnesota. The Agency consists of a Director and seven members appointed by the Governor with the advice and consent of the Senate.

The Agnecy's fiscal year 1970 budget for air pollution control activities was $219,600, with $146,400 in Federal funds and $75,200 in State funds. An increase in the budget is anticipated for fiscal year 1971, with a slight reduction in Federal funds ($133,474), but nearly a doubling of State funds ($139,939). The Agency's staff presently consists of seven full-time professionals, four part-time professionals, three full-time sub-professionals, eight part-time sub-professionals, and a full-time administrator.

PROPOSED AIR QUALITY CONTROL REGION

Subject to the scheduled Consultation, the Secretary, Department of Health, Education and Welfare, proposes to designate for an interstate air quality control region the Metropolitan Sioux Falls area consisting of the following jurisdictions:

In South Dakota	In Minnesota	In Iowa
Lincoln County	Rock County	Lyon County
McCook County		
Minnehaha County		
Turner County		

As so proposed, the Metropolitan Sioux Falls Region would consist of the territorial area encompassed by the outermost boundaries of the above jurisdictions and the territorial area of all municipalities located therein and as defined in Section 302(f) of the Clean Air Act, as amended (42U.S.C.1857h(f)). The boundaries of the proposed Region are shown in Figure 12.

Discussion

An air quality control region should meet four basic criteria:

1. It should encompass most pollution sources as well as most people and property affected by the sources.
2. It should include those areas where industrial and residential growth may create significant future problems.
3. It should be consistent with unified and cooperative administration of the region's air resources.
4. It should promote enhancement and protection of the area's future environment.

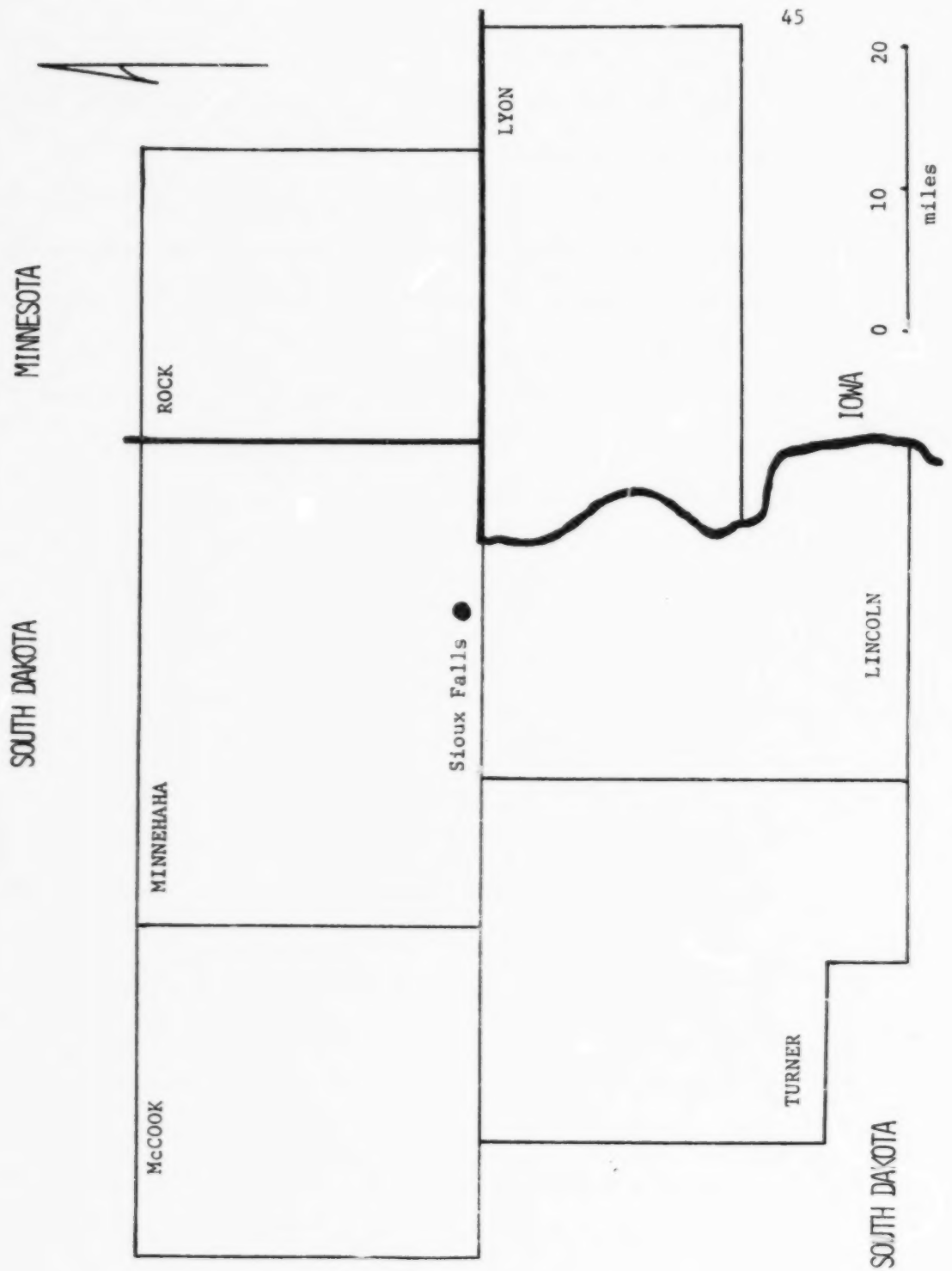


FIGURE 12 - Proposed Metropolitan Sioux Falls Interstate Air Quality Control Region

The proposed Region for the Metropolitan Sioux Falls interstate area would satisfy the requirements of these criteria.

The discussions in the preceding sections of technical, urban, and governmental factors relevant to a determination of the Region's boundaries lead to the following conclusions:

1. Most of the pollution sources in the Sioux Falls Metropolitan interstate area are located within the proposed Region. Sources of sulfur oxides and nitrogen oxides are closely concentrated within Sioux Falls. Major sources of particulates and carbon monoxide are similarly concentrated. Minor sources of particulate pollution are widely dispersed because of the location of grain elevators and feed mills throughout the proposed Region. Motor vehicle traffic in the rural areas is a dispersed but minor source of carbon monoxide.

The effects of major pollutants are mainly contained in the heavily populated part of the proposed Region. Areas outside the proposed Region which may be affected by pollution from grain elevators and feed mills are sparsely populated.

2. The Region as proposed would provide for anticipated urban growth outward in the next decade from the present center of Sioux Falls. Because the city is clustered near the center of the proposed Region, expansion in any direction could be accommodated within the boundaries proposed. Moreover, physical expansion which is likely to take place will be modest in scale,

reflecting slow population growth and a gradual increase in commercial activity. No major growth or diversification of manufacturing is expected. Hence, the proposed Region should be adequate for presently foreseeable air quality control needs as well as for those which exist today.

3. The proposed Region would permit a unified and cooperative administration of its air resources.

The South Dakota State Department of Health has responsibility for administration of air pollution control in the State of South Dakota, the Minnesota Pollution Control Agency has similar responsibilities for the State of Minnesota, and the Iowa State Department of Health is responsible for the State of Iowa. None of the States has established or proposed programs with particular reference to the counties of the proposed Region.

The six counties of the proposed Region are included in the jurisdictional area of a proposed Comprehensive Health Planning District (interstate).

The formation of a three-state Air Quality Control Region would promote cooperation among the three separate State Governments and could function in concert with the Comprehensive Health Planning District.